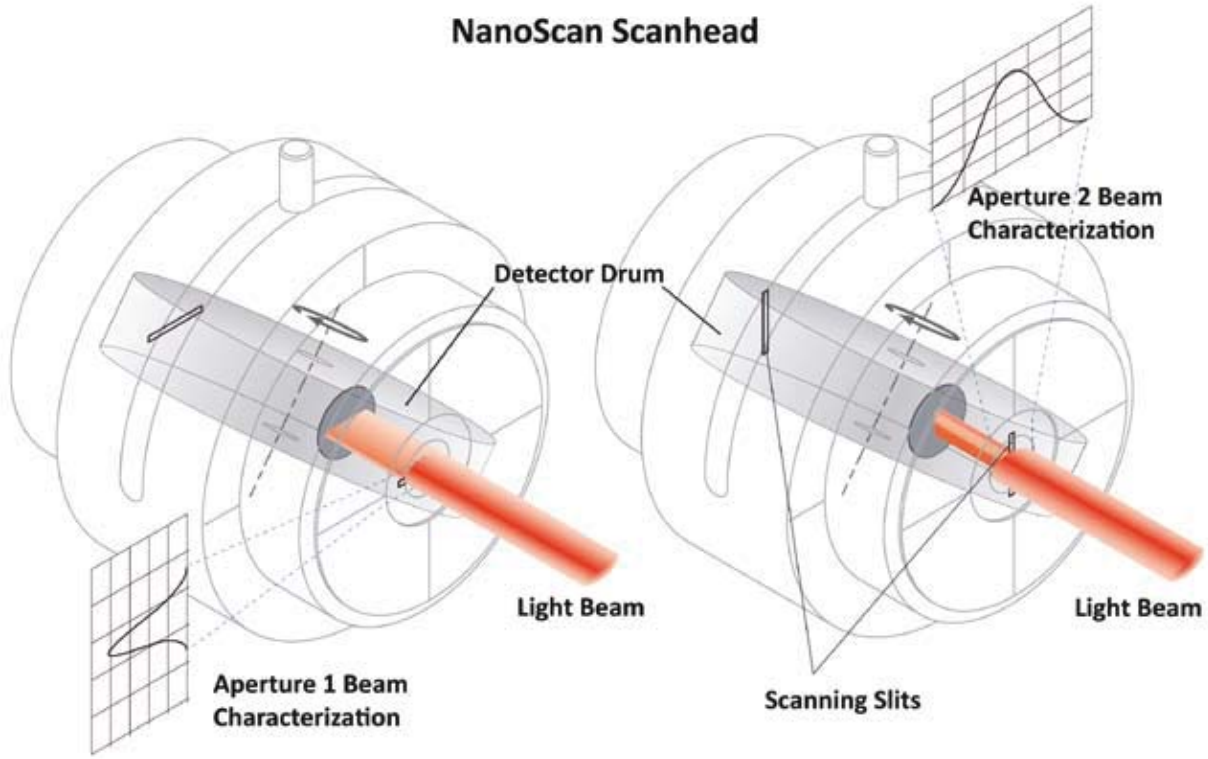
3.3 Introduction to Scanning-Slit Profilers

The scanning slit beam profiler moves two narrow orthogonal slits in front of a linear photo-detector through the beam under analysis. Light passing through the slit induces a current in the detector. Thus, as the slit scans through the beam, the detector signal is linearly proportional to the spatial beam irradiance profile integrated along the slit. A digital encoder provides accurate slit position. The photo-induced current signal is digitized and analyzed to obtain the beam profile in both X and Y from the two orthogonal slits.

The slit apertures act as physical attenuators, preventing detector saturation for most beam applications. High dynamic range amplification allows operation over many orders of magnitude in beam power.

From these profiles, important spatial information such as beam width, beam position, beam quality, and other characteristics are determined. This technique can accommodate a wide variety of test conditions. Because slit scanners measure beams at high powers with little or no attenuation, they are ideal to profile beams used in material processing.

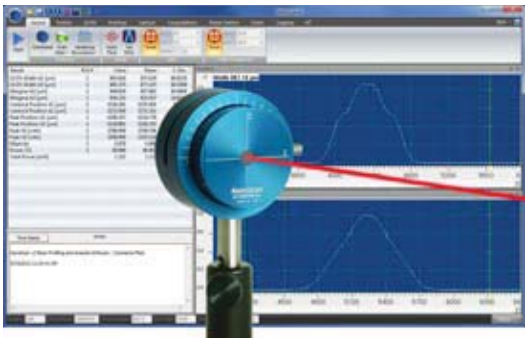
Carbon dioxide (CO2) lasers are widely used in materials processing, and have a 10.6 micron wavelength that cannot be profiled with most cameras. Slit scanners, therefore, provide an convenient means of measuring high-resolution CO2 lasers with powers up to and exceeding 1000 watts.



3.3.1 NanoScan™

Scanning Slit Beam Profiler For High Accuracy Dimensional Measurement

NanoScan is a PC-based instrument for the measurement and analysis of optical beam spatial profiles in accordance with ISO standards. Beam profiles are measured using the International Standard ISO 11146. Scanheads that are fitted with an optional power feature can measure power in accordance with ISO 13694.



The system comprises a scanhead for sensing the laser beam, a USB 2.0 controller, and NanoScan software. An optional automation feature includes an ActiveX automation server.

NanoScan uses moving slits, one of the ISO Standard scanning aperture techniques. Measurement is possible for beam sizes from microns to centimeters at beam powers from microwatts to over kilowatts, often without attenuation. Detector options (silicon, germanium, and pyroelectric technologies) allow measurement at wavelengths from the ultraviolet to the far infrared. It can simultaneously measure multiple beams and offers an optional power meter for scanheads with silicon and germanium detectors.

Profiles are acquired with 12-bit digitization, and analyzed for real-time updates up to the maximum scanhead scan rate of 20Hz. With NanoScan, beam profile measurement is extremely easy: simply position the scanhead in the beam path and within seconds the system does the rest.

Benefits

- All NanoScan systems are calibrated to a NIST traceable source to ensure the ultimate in accuracy.
- The software finds a beam in less than 0.3 seconds and displays real-time updates up to 20Hz.
- The Z-axis datum plane of the NanoScan is known to ±25µm making the locating of beam waist position simple and accurate.
- Along with the ability to measure pulsed beam diameters, the NanoScan accurately measures and reports the pulse frequency of the laser, ensuring that the pulsed beam measurements are stable and accurate.
- The sampling interval for beam measurements is adjustable to as little as 5.7nm, providing the extreme accuracy required to measure very small beams.
- Profile averaging and rolling averages are available to improve signal to noise.
- NanoScan software has built-in capability to control a mechanical linear stage for measurement of beam caustic.
- Software has a built-in M^2 Wizard to assist in making manual propagation ratio measurements.
- Time charts allow any beam result to be charted over time.
- Results logging to text files.
- Optional ActiveX Automation commands with samples of automation programs for Excel VBA, LabView and Visual Basic.net.
- Optional power meter with silicon and germanium scanhead.

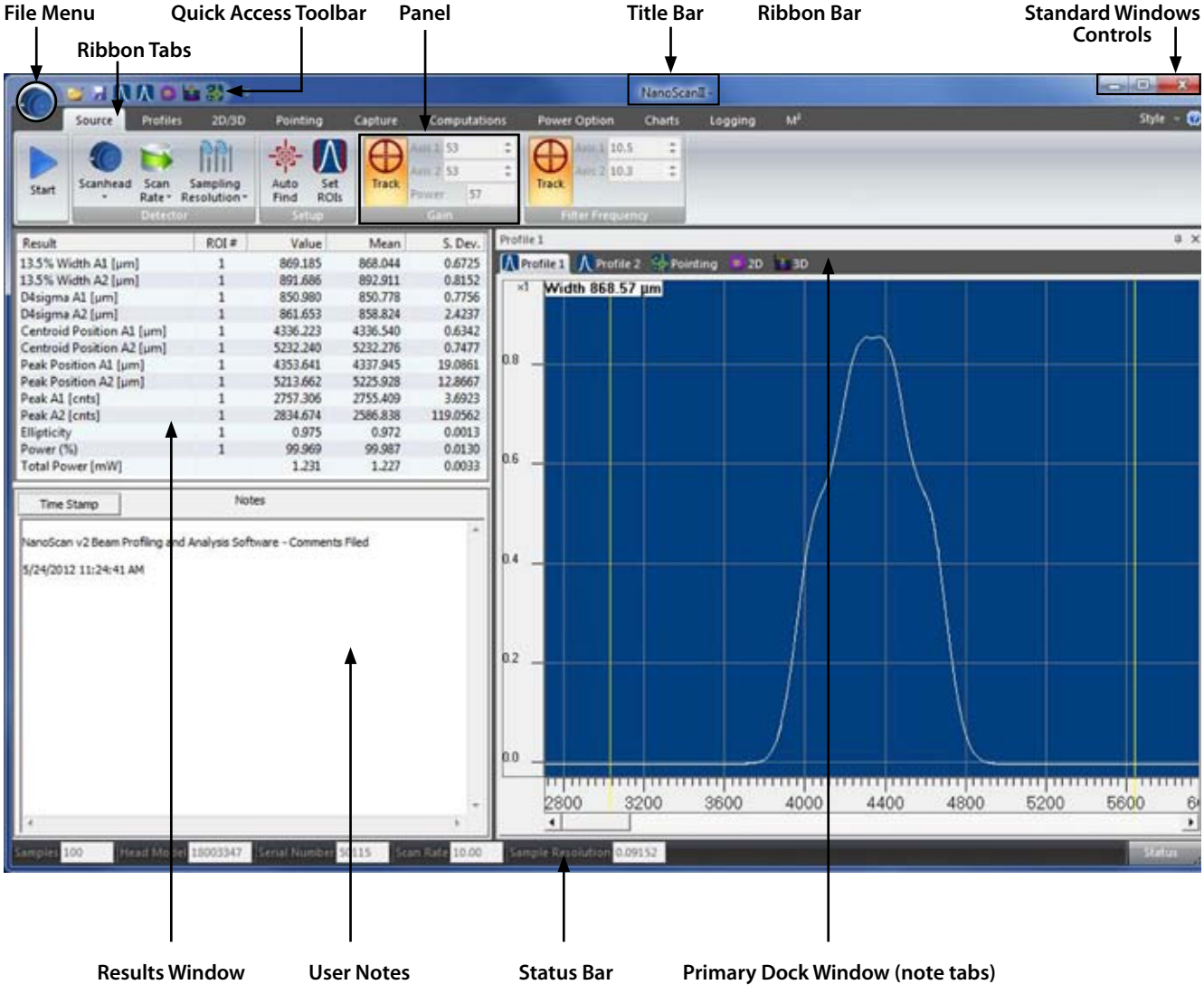
NanoScan Option NSEC: Side exit cable

Measure Your Beam as Never Before

The system has a USB 2.0 interface and operates with the latest Microsoft operating systems 64/32-bit Windows 7, and provides deep, 12-bit digitization of the signal for enhanced dynamic range up to 35dB optical power. The digital controller improves the accuracy and stability of the beam profile measurement by orders of magnitude. It is now possible to measure beam size and beam pointing with a 3-sigma precision of 1µm or better. The software controllable scan speed and a "peak-connect" algorithm allow the measurement of pulsed and pulse width modulated lasers with frequencies of a few kHz and higher with any detector.*

*The minimum frequency is a function of the beam size and the scan speed. This is a simple arithmetic relationship; there must be a sufficient number of pulses during the time that the slits sweep through the beam to generate a meaningful profile. Please refer to Photon's Application Note, Measuring Pulsed Beams with a Slit-Based Profiler.

NanoScan Main Display Screen

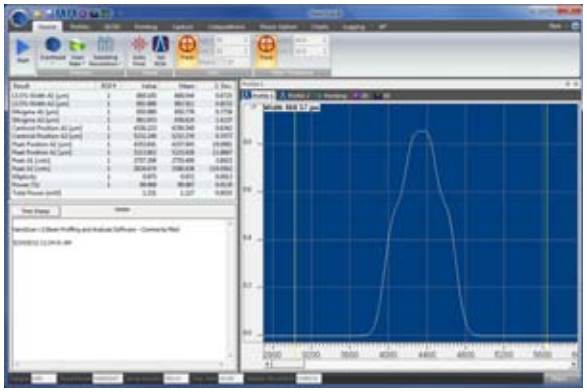


The Most Versatile and Flexible Beam Profiling System Available

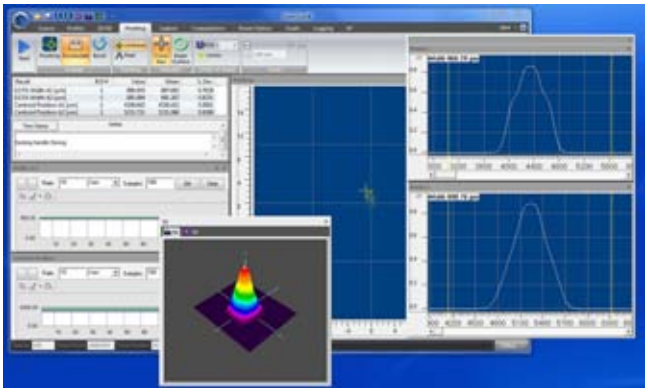
Photon's NanoScan scanning slit profilers provide major performance enhancements while maintaining the ease-of-use and flexibility that customers have come to expect with its predecessor, the world-renowned BeamScan. NanoScan scanheads are available to measure CW and pulsed beams across the entire spectral range from UV to far infrared.

See Your Beam As Never Before

The Graphical User Interface (GUI) of NanoScan is new. Dockable and floatable windows plus concealable ribbon tool bars empower the NanoScan user to make the most of a small laptop display or a large, multi-monitor desktop PC.



Simple docked view



Both docked and undocked windows

Measured Beam Results

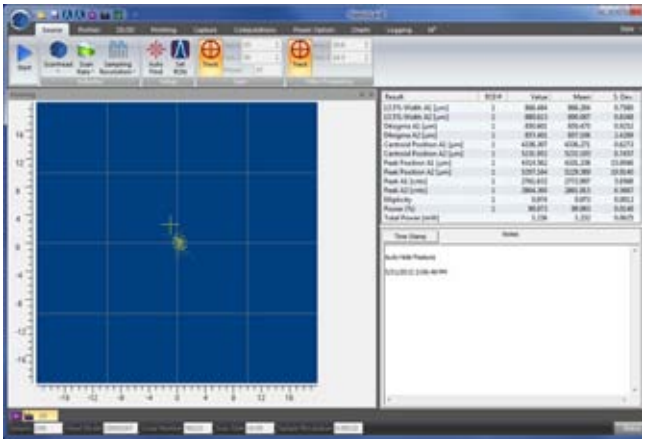
From 1989 through 1996, John Fleischer, past President of Photon Inc., chaired the working laser beam width ISO/DIN committee that resulted in the ISO/DIN 11146 standard. The final approved standard, available in 13 languages, is a compromise based on many years of work by the committee. The standard governs profile measurements and analysis using scanning apertures, variable apertures, area sensors and detector arrays. NanoScan measures spatial beam irradiance profiles using scanning slit techniques. The standard NanoScan uses the moving-slit method, approved by International Standard ISO/DIN 11146.

Results measured include:

- Beam Width at various clip levels
- Centroid Position
- Peak Position
- Ellipticity
- 1D Gaussian Fit
- Beam Divergence
- Beam Separation
- Pointing Stability
- ROI Power (optional)
- Total Power (optional)
- Peak (in digitizer counts)
- Pulsed Laser Repetition Rate

Result	ROI #	Value	Mean	S. Dev.
13.5% Width A1 [µm]	1	863.328	864.612	0.7082
13.5% Width A2 [µm]	1	876.317	875.622	0.9432
D4sigma A1 [µm]	1	849.062	849.700	1.5084
D4sigma A2 [µm]	1	842.054	840.924	2.3751
Centroid Position A1 [µm]	1	1.111	-0.133	0.5622
Centroid Position A2 [µm]	1	-1.730	0.275	1.2221
Peak Position A1 [µm]	1	-11.521	-19.890	5.6014
Peak Position A2 [µm]	1	4.156	8.732	6.9860
Peak A1 [cnts]	1	2812.438	2810.688	4.0486
Peak A2 [cnts]	1	2687.898	2678.320	5.5879
Ellipticity	1	0.806	0.807	0.0023
Power [%]	1	99.994	99.979	0.0273
Total Power [mW]		1.202	1.203	0.0002

Example of the many measurements that can be made and the precision you can expect



Knowing pointing stability is a critical factor in laser performance

Multiple Beam Analysis Software

The NanoScan software is an integrated package for Microsoft Windows operating systems, it can measure from one to 16 beams in the NanoScan aperture, all with sub-micron precision. The optimal-pro software includes ActiveX automation for users who want to integrate the NanoScan into OEM systems or write their own user interface screens.

M^2 Wizard

M-squared (M^2) software Wizard is an interactive program for determining the "times diffraction limit" factor M^2 by the Rayleigh Method. The M^2 Wizard prompts and guides the user through a series of manual measurements and data entries required for calculating M^2.

The Optional Rayleigh Range Translation Test Fixture (RAL-FXT) provides convenient translation of a NanoScan scanhead assembly and a digital readout of its relative position along the Z-axis. Used with a user-provided focusing lens and the M^2 Wizard in the NanoScan Analysis Software, this fixture offers a quick and easy method to determine the times-diffraction propagation factor (M^2) of a laser.

The optional Translation Test Fixture makes manual M2 measurements accurate and repeatable

The RAL-FXT features a base plate, sliding carriage and digital micrometer. The base plate (5.4×10.2×0.38in.) provides a series of ¼-20 threaded mounting holes at 2in. centers to facilitate convenient fixturing of the assembly with respect to the focusing lens. The sliding carriage accommodates the combination of the 0.125-in. dowel pin and the ¼-20 mounting hole found on any Photon scan head's rotation mount, and enables smooth movement of the scan head assembly over a 6-in. range of travel. A Mitutoyo micrometer with a handy re-zeroing feature and accompanying slide provides precise determination of the scan head location and/or travel distance with a resolution of tens of microns.

For automated and automatic M^2 measurements the NanoModeScan option is required.

Pulsed Laser Beam Profiling

In addition to profiling CW laser beams, NanoScan can also profile pulsed laser beams with repetition rate in the 1kHz range and above. To enable the measurement of these pulsed lasers, the NanoScan profiler incorporates a "peak connect" algorithm and software-controlled variable scan speed on all scanheads. The accuracy of the measurement generally depends on the laser beam spot size and the pulse-to-pulse repeatability of the laser. The NanoScan is ideal for measuring Q-switched lasers and lasers operating with pulse width modulation power (PWM) control. In the past few years, lasers with pico- and femtosecond pulse durations have begun to be used in many applications. Although these lasers add some additional complication to the measurement techniques, the NanoScan can also measure this class of laser.

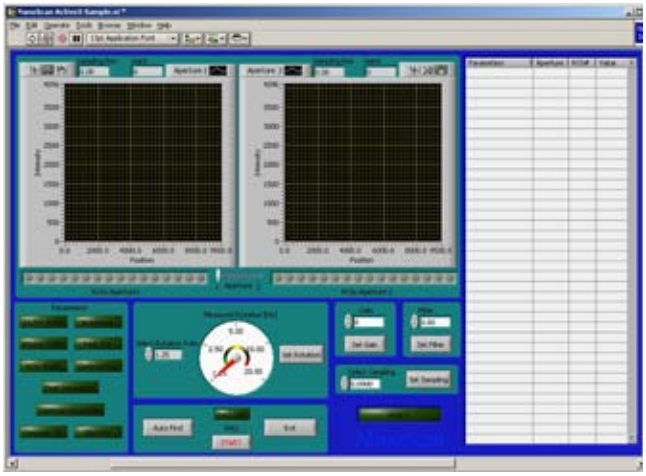
Optional Power Meter

The silicon and germanium NanoScan systems offer the 200mW power meter as an option. The power meter can be calibrated against the user's ISO- or NIST- traceable power meter. The 200mW power meter has a quartz attenuator window that provides a uniform response across a broad wavelength range with a 1.5% accuracy when used in the same geometry as calibrated.

The power meter screen in the software shows both the total power and the individual power in each of the beams being measured. The power meter option is not available with pyroelectric detectors.

Optional Automation Interface

The Pro model scanheads implement an Automation Server that can be used by an Automation Client written in Visual Basic for Applications (VBA), C/C++ or by an application with support for ActiveX Automation, such as Microsoft Excel, Microsoft Word or National Instruments' LabVIEW.



Full featured application examples are included to help your learning curve when embedding NanoScan - PRO into an automation application

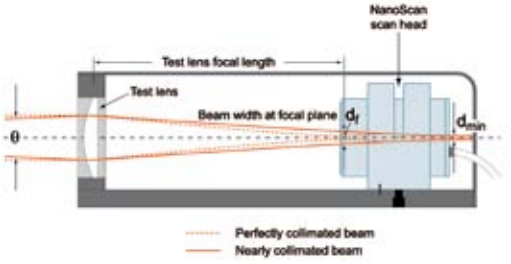
Optional Collimation Fixture

A single beam size measurement using a Collimation Fixture is all that is required to determine laser beam collimation or divergence angle. Real-time optical alignment can then be performed to determine best collimation. No special training is needed to perform these simple measurements. Unlike with most measurement shortcuts, high-precision collimation measurements can be performed with exceedingly high resolution, higher than alternative techniques. All that is required for these accurate measurements of collimation is a test lens and a NanoScan. The laser beam profiler is positioned such that it measures beam size at the geometric focus of the lens. From lens theory, the angle of collimation is determined by the equation: $q = D_f / f$, where q is the angle of collimation, D_f is the beam size measured at the focal length, and f is the focal length of the lens. Once the beam size is measured at the focal length of the lens, simply dividing this measured beam size by the divergence angle determines the laser beam collimation angle. The beam profiler remains fixed, and active alignment is easily performed in real time. This level of simplicity, speed, and functionality is simply not possible with techniques involving multiple beam profile positions.

Divergence/Collimation test fixtures based on a high quality test lens to focus your collimated or diverging beam.

Fixtures require a complete NanoScan System.

COL-FXT 250	Nominal 250mm focal length lens. Includes an enclosure to block stray light
COL-FXT 250 TEL	Nominal 250mm focal length lens. For wavelengths of use at 1310 or 1550nm with lens repositioning. Includes an enclosure to block stray light
COL-FXT 500 MIR	For wavelengths of use at 3–5µm.
COL-FXT C02	Zinc selenide (ZnSe) lens with a focal length of 190.5mm. For wavelength of use at 10.6m. Includes an enclosure that holds an adjustable entrance iris. Requires a Pyro NanoScan System.



NanoScan Configurations

Detector Type	Power Range	Wavelength	Aperture	Slits	Scanhead Size
Silicon	~100nW-~100mW	190nm-950nm	25mm	25µm	100mm
Germanium	~1µW-~100mW	700nm-1800nm	12mm	25µm	100mm
Pyroelectric	100mW-100W	190nm- >20µm	9mm	5µm	63mm
				25mm	
			20mm	25µm	100mm

The power that can be handled by the NanoScan is dependent on the wavelength of the light to be measured. The wavelength of light determines both its reflectivity from the slit surfaces and the energetic nature of the interactions with materials. As a rule of thumb, there are three basic wavelength regimes that govern how much power the scanhead can handle:

- 3µm to FIR (>20µm) –100W maximum pyroelectric detector
- 700nm to 3µm—25W maximum pyroelectric detector; 1W germanium detector
- 190nm to 700nm—3W maximum pyroelectric detector; 1W silicon detector

Power levels above these for any of these wavelengths can be considered "High Power." See the High Power NanoScan section for appropriate products. **Consult the damage thresholds charts found in the manual before placing an order or exposing any NanoScan slit profiler to a laser beam.**

NanoScan Acquisition and Analysis Software

*Feature		NanoScan Standard	NanoScan Professional (all features in Standard plus)
Controls			
Source	ScanHead Select, Gain, Filter, Sampling Resolution, AutoFind, Rotation Frequency, Record Mode	●	
Capture	Averaging, Rotation, Magnification, CW or Pulse Modes, Divergence, Gaussian Fit, Reference Position, Recompute	●	
Regions of Interest (ROI)	Single or Multiple, Automatic or Manual, Colors	●	
Profiles	Vertical Scale (1´, 10´, 100´), Logarithmic Scale, Z & PAN (Automatic or Manual)	●	
Computation: ISO 13694, ISO 11146	D_{slit}, (13.5%, 50% 2 User Selectable Clip Levels), $D_{4\sigma}$, Width ratios, Centroid Position, Peak Position, Centroid Separation, Peak Separation, Irradiance, Gaussian Fit, Ellipticity, Divergence, Total Power, Pulse Frequency, % power	●	
	Continuous, Rolling, Finite	●	
Pointing	Centroid or Peak, Accumulate Mode, Beam Indicator, Graph Center, Colors	●	
2D/3D	2D or 3D Mode, Linear or Logarithmic Scale, Resolution, Fill Contours, Solid Surface, or Wireframe, Clip Level Colors	●	
Charts	Chart Select, Parameter Select, Aperture Select, Update Rate, Start and Clear	●	
Logging	File Path/Name, Delimiter, Update Rate	●	
M^2	Rail Setup: Com Port and Length, Connect/Disconnect, Rail Control	●	
Views			
Profiles	Displays Beam Profiles for each axis, with optional Gaussian Overlays	●	
Results	Displays Values and Statistics for Selected results	●	
Pointing	Displays the XY position of the Centroid or Peak for each ROI , with optional overlays and Accumulate Mode	●	
Charts	Displays Time Charts for User-selected results	●	
2D/3D	Displays pseudo 2D/3D Beam Profile	●	
M^2 Wizard	An interactive procedure for measuring M2 by the Rayleigh Method	●	
File Saving			
NanoScan Data Files		●	
Text Files		●	
Data Logging			
Log to File		●	
Reports			
NanoScan Report		●	
Automation Interface			
ActiveX Automation Server			●
Minimum System Requirements			
PC computer running windows7 (32/64) Laptop or Desktop			
Core CPU 2GHz or better			
3GB of RAM or better			
1 USB 2.0 port			
At least 250MB free HDD space			
1440x900 Display Resolution or greater			
Add-in PCI/PCI-Express graphics card w/hardware acceleration			
DVD-ROM drive			

*Download the NanoScan Acquisition and Analysis Software Manual for a complete description of all Software Features

Ordering Information - NanoScan Systems

Both -STD & -PRO NanoScan Systems Include: NanoScan v2 Integrated Software package for use with NanoScan scanheads under Microsoft Windows operating systems.

ActiveX automation is provided in -PRO models.

Certificate of Calibration. Beam width is traceable to National Institute of Standards and Technology (NIST) to better than ±2% (NanoScan Pyroelectric detectors calibration to better than ±3%).

Item	Description	P/N
USB NS-Si/25/25-STD	NanoScan Si Detector 25mm aperture 25micron slits. High-resolution head featuring Si detector, 100mm diameter head with rotation mount, 25mm entrance aperture, and matched pair of 25.0micron wide slits. Use from 190nm to wavelengths <1micron. Not for 1.06micron wavelength. USB	PH00390
USB NS-Si/25/25-PRO	Software includes automation feature. NanoScan Si Detector 25mm aperture 25micron slits. High-resolution head featuring Si detector, 100mm diameter head with rotation mount, 25mm entrance aperture, and matched pair of 25.0micron wide slits. Use from 190nm to wavelengths <1micron. Not for 1.06micron wavelength. USB	PH00019
USB NS-Ge/12/25-STD	NanoScan Ge Detector 12.5mm Aperture 25micron slits. High-resolution head featuring Germanium detector, 100mm diameter head with rotation mount, 12.5mm entrance aperture, and matched pair of 25micron wide slits. USB	PH00395
USB NS-Ge/12/25-PRO	Software includes automation feature. NanoScan Ge Detector 12.5mm Aperture 25micron slits. High-resolution head featuring Germanium detector, 100mm diameter head with rotation mount, 12.5mm entrance aperture, and matched pair of 25micron wide slits. USB	PH00024
USB NS-PYRO/9/5-STD	NanoScan Pyroelectric Detector 9mm aperture 5micron slits. High-resolution head featuring pyroelectric detector, 63.5mm diameter head with rotation mount, 9mm entrance aperture, and matched pair of 5µm wide slits. Use for wavelengths from 190nm to >20µm. This model does not include a cooling fan. USB	PH00396
USB NS-PYRO/9/5-PRO	Software includes automation feature. NanoScan Pyroelectric Detector 9mm aperture 5micron slits. High-resolution head featuring pyroelectric detector, 63.5mm diameter head with rotation mount, 9mm entrance aperture, and matched pair of 5µm wide slits. Use for wavelengths from 190nm to >20µm. This model does not include a cooling fan. USB	PH00025
USB NS-PYRO/9/25-STD	NanoScan Pyroelectric Detector 9mm aperture 25micron slits. High-resolution head featuring pyroelectric detector, 63.5mm diameter head with rotation mount, 9mm entrance aperture, and matched pair of 25µm wide slits. Use for wavelengths from 190nm to >20µm. This model does not include a cooling fan.	PH00400
USB NS-PYRO/9/25-PRO	Software includes automation feature. NanoScan Pyroelectric Detector 9mm aperture 25micron slits. High-resolution head featuring pyroelectric detector, 63.5mm diameter head with rotation mount, 9mm entrance aperture, and matched pair of 25µm wide slits. Use for wavelengths from 190nm to >20µm. This model does not include a cooling fan.	PH00228
USB NS-PYRO/20/25-STD	NanoScan Large Area Pyroelectric Detector 20mm aperture 25micron slits. High-resolution head featuring pyroelectric detector, 100mm diameter head with rotation mount, 20mm entrance aperture, and matched pair of 25micron wide slits. Use for wavelengths from 190nm to >20micron. This model does not include a cooling fan. USB	PH00397
USB NS-PYRO/20/25-PRO	Software includes automation feature. NanoScan Large Area Pyroelectric Detector 20mm aperture 25micron slits. High-resolution head featuring pyroelectric detector, 100mm diameter head with rotation mount, 20mm entrance aperture, and matched pair of 25micron wide slits. Use for wavelengths from 190nm to >20micron. This model does not include a cooling fan. USB	PH00026
NS-USB	NanoScan USB Controller /NS USB	PH00030
NH NS-Si/25/25-STD	Head only NanoScan-Si 25mm aperture 25µm slits	PH00406
NH NS-Si/25/25-PRO	Head only NanoScan-Si 25mm aperture 25µm slits	PH00035
NH NS-Ge/12/25-STD	Head only NanoScan-Ge 12mm aperture 25µm slits	PH00411
NH NS-Ge/12/25-PRO	Head only NanoScan-Ge 12mm aperture 25µm slits	PH00040
NH-PYRO/9/5-STD	Head only NanoScan-Pyro 9mm aperture 5µm slits	PH00412
NH-PYRO/9/5-PRO	Head only NanoScan-Pyro 9mm aperture 5µm slits	PH00041
NH-PYRO/9/25-STD	Head only NanoScan-Pyro 9mm aperture 25µm slits	PH00416
NH-PYRO/9/25-PRO	Head only NanoScan-Pyro 9mm aperture 25µm slits	PH00243
NH-PYRO/20/25-STD	Head only NanoScan-Pyro 20mm aperture 25µm slits	PH00413
NH-PYRO/20/25-PRO	Head only NanoScan-Pyro 20mm aperture 25µm slits	PH00042
Software Upgrades		
NSv2 STD to NSv2 PRO Upgrade	Upgrade NanoScan v2 Standard version software to the PRO version. This upgrade opens the NanoScan automation feature for those users wanting to integrate or develop their own interface using Visual Basic for Applications to embed into such applications as LabView. Return scanhead to factory.	PH00417
NSv1 to NSv2 STD Upgrade	For those NanoScan users with pre v2 software (approx. before July 2012) they can upgrade their hardware to v2 STD capability and can run the new software. Automation capability is not available in v2 STD. Once upgraded the legacy software will run but the automation feature will be disabled in v2	PH00418
NSv1 to NSv2 PRO Upgrade	For those NanoScan users with pre v2 software (approx. before July 2012) they can upgrade their hardware to v2 PRO capability and can run the new software. Automation capability is included in v2 PRO. Once upgraded the legacy software will run including the automation capability in v2	PH00419
Legacy Software	Purchase the legacy V1.47 NanoScan software with licence and operations manual to –PRO scanheads to use the older software. (return scanhead to factory)	PH00420

NanoScan Options and Accessories

Item	Description	P/N
P200 Power Option	200mW (maximum power level) relative power meter option for Silicon or Germanium detector NanoScans. The /P200 provides better than 1.5% accuracy when calibrated against user's NIST traceable power meter and used in similar input geometry as calibrated.. Not applicable to Pyro-electric detector scan heads NOTE: P200 must be specified at time of purchase (Can be returned for upgrading)	PH00046
NSEC	Side exit cable option for NanoScan	PH00252
Cable-x	Custom NanoScan cable-length x	PH00049
NS-YE	Extension NanoScan cable 3m	PH00050
C-Mnt	C-Mount attachment for NS	PH00051
COL-FXT 250	250 mm FL collimation fixture	PH00070
PFSA	UV-Grade fused silica right angle prism front surface attenuator in C-mount housing. Provides 4% front surface reflection	PH00052
DPFSA	Dual prism front surface attenuator comprising two UV-Grade Fused silica right angle prism units configured orthogonally to preserve polarization in a C-mount housing	PH00053
COL-FXT 250 TEL-X	250 mm FL collimation fixture 1550nm	PH00071
COL-FXT CO2	Collimation Fixture for 10.6µmWL	PH00072
RAL-FXT	Rayleigh fixture for manual M2	PH00073
RSP100	RailScan motion stage 100mm length	PH00078
RSP200	RailScan motion stage 200mm length	PH00079
RSP500	RailScan motion stage 500mm length	PH00080
H-I LA	Modify H-I for Large (100mm) Scan head	PH00082
H-I 980-VIS w/lens	NS lens mount bracket and 60X lens 980 WL	PH00146
H-I 1550 w/ lens	NS lens mount bracket and 40X lens 1550 WL	PH00081
H-I High energy IR	NS lens mount bracket w/ high energy lens WLxxx	PH00147
H-I 100X	NS lens mount bracket and 100X lens WLxxx	PH00148

Power attenuation options

ND stand for Neutral Density, a term used in photography to designate that a specific filter will attenuate all wavelengths across the visible equally or neutrally. This is the name given to the Wratten type 96 filters, which come in various Optical Densities, ND1, ND2, ND0.5, etc. however, the proper term for beam profiling is Optical Density, so the options should be OD1, OD2 etc.

Item	Description	P/N
HP-ND1 350 thru 399nm	Must be ordered w/new system – Si only	PH00370
HP-ND1 400 thru 700nm	Must be ordered w/new system – Si only	PH00371
HP-ND2 400 thru 700nm	Must be ordered w/new system – Si only	PH00372
HP-ND3 400 thru 700nm	Must be ordered w/new system – Si only	PH00373
HP-ND1 750 thru 890nm	Must be ordered w/new system – Si & Ge only	PH00374
HP-ND2 750 thru 890nm	Must be ordered w/new system – Si & Ge only	PH00375
HP-ND3 750 thru 890nm	Must be ordered w/new system – Si & Ge only	PH00376
HP-ND1 900 thru 1100nm	Must be ordered w/new system – Ge only	PH00377
HP-ND2 900 thru 1100nm	Must be ordered w/new system – Ge only	PH00378
HP-ND3 900 thru 1100nm	Must be ordered w/new system – Ge only	PH00379
HP-ND1 1150 thru 1600nm	Must be ordered w/new system – Ge only	PH00380
HP-ND2 1150 thru 1600nm	Must be ordered w/new system – Ge only	PH00381
HP-ND3 1150 thru 1600nm	Must be ordered w/new system – Ge only	PH00382